TELEMETRICS

MODEL 513

STORED PROGRAM SIMULATOR

FEATURES

Simulates any known format regardless of complexity.

Simulates any digital or analog format: PCM, PDM, PAM, PACM.

Stores several formats simultaneously; PCM along with PDM and PAM.

No practical limitation on word length, frame length, number of special words, or number of channels that may be supercommutated or subcommutated.

Generates PAM signals of 512 different amplitudes.

Generates PDM pulses of 250 different widths.

Simulates any format with either a multiple of static words or with words that change dynamically.

Generates an output wavetrain (from the stored format) containing the precise perturbations common to rf receivers or video tapes.

Produces data words, time codes, sine waves, XY coordinates, nonlinear analog signals, or square, sawtooth or trapezoidal waves.

MODEL 513

STORED PROGRAM SIMULATOR

The Telemetrics Model 513 Stored Program Simulator is designed to evaluate, checkout, and calibrate PCM, PAM, and PDM decommutation systems; digital or video tape systems; digital and analog computers; quick-look devices; XY plotters, and telemetry data processing routines.

A Truly Unique Simulator.   The Model 513 consists of: 20 x 256 core memory, 8-bit address register, 20-bit input/output register, 18-bit shift register, and various perturbation generating circuits.

Signals to be generated are first stored as binary bits in the core memory by means of switches located on front panel or by automatic entry equipment such as a paper tape reader. Upon a start command (push button signal), the stored binary data are retrieved from memory via the input/output register and then transferred in parallel to the shift register where they will either be shifted out serially as PCM signals or converted to analog voltages as PAM or PDM signals. The precision perturbation circuits allow modification of the output wavetrain to provide an exact simulation of signals as normally received from receivers and tape recorders. Signal-to-noise ratios may be easily established and such effects as wow, bounce, flutter, jitter, attenuation, and amplitude and bit-rate variations may be added to the output signal. PAM and PDM signals may be generated as well as PCM and PACM.

Large memory for complete telemetry formats.   Any known format may be accommodated, even as complex as Gemini. Multiple formats stored simultaneously. PCM formats stored along with PDM and PAM. The same format may be stored several times, each time with different data values.

Words and Frames of any length.   Word and frame length is limited only by the ultimate capacity of the memory. The number of unique special words that may be used is limited only by the word length. For example, if the word length were 16 bits, the total number of unique special words would be 254. Any or all words in the main frame, subframe, or sub-subframe may be subcommutated or supercommutated.

256 PAM Amplitudes...250 PDM Pulse Widths.   In the PAM mode, the 513 can produce signals with 512 unique amplitudes instead of the conventional baseline, 0%, 50% and 100%. In the PDM mode, the simulator can generate pulses from 2 to 252 multiples of the selected commutation rate.

Operational Simplicity   A flip of the switch changes signal format.

PCM   PDM   PAM
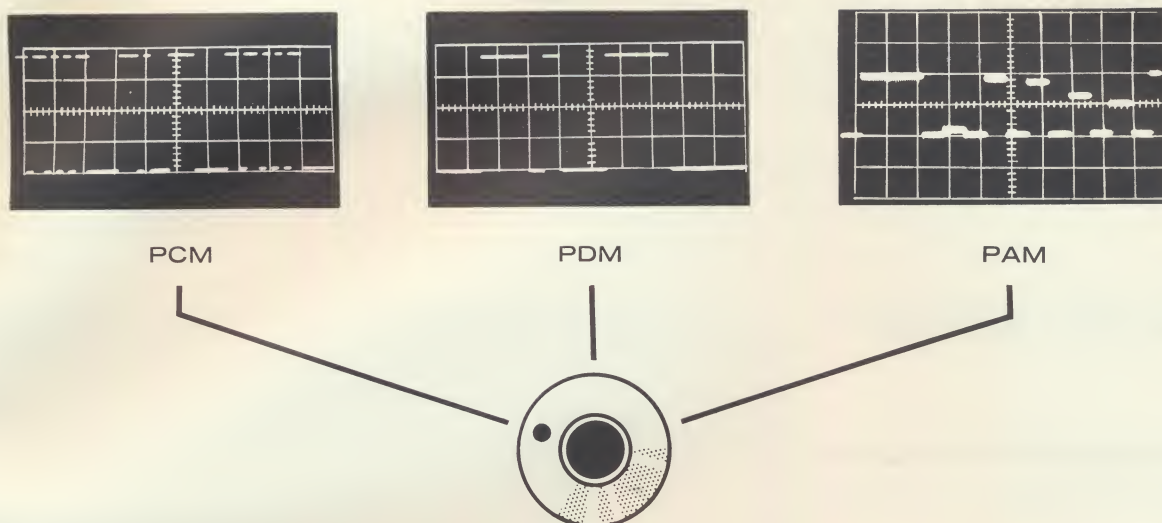
Operational Simplicity   A flip of the switch changes signal format.

Output Virtually Unlimited.   Serial or parallel output wavetrains may be coded in binary, BCD, excess 3, or any other digital code. The type may be RZ, NRZ-M 1's, NRZ-M 0's, bi-phase, or bi-phase-M. The signal may be positive or negative. The output wavetrain may be operationally mixed with perturbations to provide precise simulation of tape recorder or receiver output; all such perturbations as wow, flutter, skew, dropped bits, jitter, crosstalk and noise may be mixed without amplitude attenuation. The 513 is not limited to the generation of PCM, PDM, and PAM signals, the simulator can also produce ID codes, time codes, XY coordinates, nonlinear analog signals, and a variety of waveforms such as sine, trapezoidal, square, and sawtooth.

Provides full capability for checkout of complete ground stations.   Quick-look devices may be easily calibrated to discrete values. The 513 may be used to measure the accumulated noise of a full ground station: 1. When the simulator is programmed to produce a format containing static data words, the amount of changing data detected at the output of the ground stations is a measure of accumulated noise. 2. When the simulator is programmed to produce a format containing changing data words and errors are measured, the difference between static errors and dynamic errors is a measure of the ability of the system to track.

The 513 may be used to evaluate stations and to determine error distributions under conditions of input noise. By running a constant format while varying the input perturbations, not only may error rates for worst conditions be measured, but it may also be determined whether the noise is Gausian or random.

The 513 may be used in evaluation and checkout of digital and analog tape systems. By using the simulator as the direct input and by adding precise vaues of receiver perturbation, tapes may be prepared and examined for system performance.

The 513 may be used to check out patchboards and computer routines by providing an exact simulation of the operational format.

Versatility Guarantees Against Obsolescence.   Any information stored in memory may be displayed on the front panel. Operation may be initiated at any point in the format; for instance, in the middle of a frame. The operation may be stopped at any point, and may be manually single pulsed. Blanking may be random or discrete; the quantity of data blanked may be random, may be for a timed interval, or may begin with one word and end with another.

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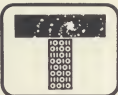
MODEL 513

STORED PROGRAM SIMULATOR

PCM OUTPUT

CODING:
Binary, BCD, excess 3, hexidecimal, or any other digital code.

TYPE:
RZ, NRZ-M 1's, NRZ-M 0's, NRZ-S, bi-phase, bi-phase M, or NRZ-S with multiple frequencies (bit rate for NRZ-S multiple frequencies are: $\leqq$ 100 kc for multiple of 8; $\leqq$ 200 kc for multiple of 4; $\leqq$ 500 kc for multiple of 2).

BIT RATE:
Adjustable from 10 cps to 1 megacycle or single pulse.

WORD LENGTH:
Any number of bits (however, higher bit rates require a certain minimum of bits when two adjacent channels are subcommutated e.g., 8 bits per word minimum at bit rate = 300 kc).

SPECIAL WORDS:
Hundreds of different special words (for instance 508 8-bit words).

DYNAMIC SPECIAL WORD:
Any one word in the format can be altered by front-panel control, without disturbing memory content, while format is generated.

FRAME LENGTH:
Almost any length (for instance, 8128 sixteen-bit words).

SUBCOMMUTATED CHANNELS:
Any word location in main or subframe may be subcommutated.

SUBCOM FRAME LENGTH:
Any length (for instance, 1024 sixteen-bit words).

SUPERCOMMUTATION:
Any number of words in either the main frame or a subframe may be cross-strapped any number of times.

OSCILLATOR OUTPUT:
Frequency is same as selected commutation rate; amplitude 0 to —12V.

PULSE RISE AND FALL TIMES:
Less than 0.2 μsec.

OUTPUT IMPEDANCE: 1000 ohms.

VOLTAGE AMPLITUDE:
Plus and minus voltage outputs adjustable between 0 and 12 volts.

PDM OUTPUT

COMMUTATION RATE:
Variable up to 4 kc.

FRAME SYNC:
Any selected number of missing channels.

COMMUTATION RATE JITTER:
Peak-to-peak jitter less than 0.1% of channel period.

STABILITY:
Within 0.25% of full scale for 8 hrs.

ACCURACY:
Within 0.25% of full scale for 8 hrs.

PULSE WIDTH:
8 μsec minimum variable from 2 to 152 multiples of clock frequency.

SPECIAL CHANNEL:
Any one channel in the format can be altered by front-panel control, without disturbing memory content, while format is generated.

PAM OUTPUT

COMMUTATION RATE:
Variable up to 40 kc for RZ and 80 kc for NRZ (100% duty cycle).

AMPLITUDE VARIATION:
Either 0 to +10 V or 0 to —10 V; rated load impedance 10K ohms or greater.

DUTY CYCLE:
30% to 70% for RZ at channel rate $\leqq$ 12 kc in 1 μsec increment. 50% for RZ at 20 kc channel rate.

INFORMATION AMPLITUDES:
512 discrete voltage levels. (Resolution 8 bits plus sign bit).

LINEARITY:
Within ±0.25% from best straight line.

STABILITY:
Within ±0.25% of full scale for 8 hours.

SPECIAL CHANNEL:
Any one channel in the format can be altered by front-panel control, without disturbing memory content, while format is generated.

MASTER PULSE DURATION:
From 1 to 128 channel periods.

CODE WORD SYNC:
Possible for channel period $\geqq$ 8 μsec times the number of bits in the code word.

REFERENCE LEVEL:
—100% to +100% of full scale.

COMMUTATION RATE JITTER:
Peak-to-peak jitter less than 0.1% of channel period.

OUTPUT CONTROLS

COMMUTATION RATE:
Adjustable from 10 cps to 1 megacycle; provisions for single pulse and external oscillator.

RATE JITTER:
60 cycles internal ±20%, with provision for external input.

BLANKING:
Manually selectable in 6 discrete intervals: 10 μsec, 100 μsec, 1 ms, 10 ms, 100 ms and 1 sec; or automatic blanking between 2 memory addresses in the format program. Provisions for external input.

NOISE:
30 cycles to 500 kc (±7 db) internal source. Provisions for external input.

OUTPUT FILTER:
Variable rise times from 1 μsec to 10 ms.

BASELINE VARIATION:
Six selectable ranges, continuously variable. Wave shape and amplitude dependent on bit pattern.

POWER REQUIREMENTS
115v ac ±10%, single phase, 60 cps ±10%, 6 amps.

PHYSICAL CHARACTERISTICS

MOUNTING:
Standard 19-inch relay rack (slides provided on request or individual cabinet) (optional at extra cost.)

OUTPUT CONNECTORS:
MS type (quick disconnect) normally supplied.

WIRING:
Point-to-point taper pin.

FINISH:
Fed Std 595 light tan 23617 (other colors optional at extra cost).
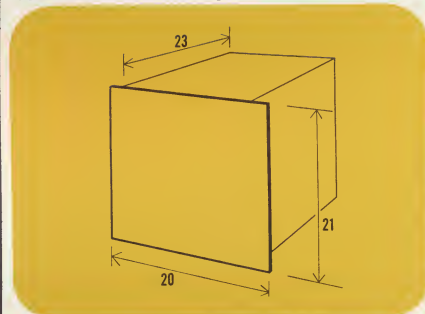
SIZE:
21" high, 20" wide and 23" deep.

WEIGHT:
150 lb.

TEMPERATURE:
Operating: 0 to 38°C, 95% relative humidity without condensation, and barometric pressure between 30 and 20.6" Hg.

Nonoperating: 0 to 65°C, 95% relative humidity with condensation, and barometric pressure between 30 and 5.54" Hg.

TELEMETRICS INC.

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